COMMENT   **Open Access**

Leveraging one health as a sentinel approach for pandemic resilience

Maggie L. Bartlett[1,2]* and Marcela Uhart[3]

Abstract

The resurgence of H5N1 avian influenza highlights the urgent need for robust surveillance systems to detect zoonotic risks before they evolve into human-to-human transmission. The One Health approach—integrating human, animal, and environmental health—offers a comprehensive framework for addressing these challenges. H5N1, a highly pathogenic avian influenza virus, has caused significant mortality in avian populations and poses a serious threat to human health. While human cases are rare, alarming outbreaks in mammals, such as elephant seals with up to 96% mortality, emphasize the importance of early detection in animal populations. Traditional surveillance methods, which often focus solely on human cases, are reactive and may be too late to prevent widespread transmission. One Health enhances early warning systems by monitoring wildlife, livestock, and environmental samples, identifying viral spillover events at their source, and enabling timely interventions to contain the virus before it reaches human populations.

The recent resurgence of H5N1 avian influenza underscores an urgent need for robust surveillance systems to preemptively detect and mitigate zoonotic risks before they escalate into human-to-human transmission. The One Health approach—integrating human, animal, and environmental health perspectives—provides a comprehensive framework for addressing these challenges effectively. Yet, despite its significant preventive potential, it remains underutilized.

H5N1, a highly pathogenic avian influenza virus, has inflicted severe mortality on avian populations and poses a substantial threat to human health. Although human cases are relatively rare, alarming outbreaks in mammals

such as elephant seals, which have experienced up to 96% mortality rates, serve as stark warnings we cannot ignore [1, 2]. Traditional surveillance methods, which often focus solely on human cases, are reactive and may come too late to prevent widespread transmission [3]. In contrast, the One Health approach highlights the interconnectedness of all life from human-dominated to untouched ecosystems and emphasizes the importance of early detection in animal populations as a sentinel for potential human outbreaks [4].

Imagine trying to spot a wildfire before it consumes an entire forest. Just as early detection of smoke and heat is crucial for forest fire management, the early identification of zoonotic threats in animal populations is vital for preventing human outbreaks. However, our current systems are like using a single smoke detector for an entire forest—insufficient and often too late [5].

One Health offers a proactive strategy by enhancing early warning systems through coordinated monitoring of wildlife, livestock, and environmental samples [6]. This approach allows for identifying viral spillover events at

*Correspondence:
Maggie L. Bartlett
mlbartlett@gvn.org
[1]Global Virus Network, Tampa, Florida, USA
[2]Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland, USA
[3]One Health Institute, School of Veterinary Medicine, University of California-Davis, Davis, California, USA

their source, enabling timely and targeted interventions to contain the virus before it reaches human populations. Moreover, it fosters collaboration across sectors, facilitating the sharing of data and resources to mount a more agile and effective response [7].

Integrating genomic surveillance, ecological studies, and epidemiological modeling within a One Health framework provides crucial insights into the transmission pathways of H5N1 [8]. This holistic perspective is essential for understanding the factors driving the emergence and spread of the virus and for devising public health strategies that are both timely and context-specific [9]. In several studies, animal sentinel surveillance has shown significant cost savings compared to human surveillance. For example, the West Nile virus (WNV) sentinel bird surveillance program in California was estimated to cost $2.5 million annually which saved the state $10.9 million by preventing 136 human cases over three years, translating to a 4.36:1 cost-benefit ratio. In the case of influenza surveillance in pigs; early detection programs have been shown to save up to $50 million annually in healthcare costs and pandemic response efforts, compared to the program costs of around $5 million for surveillance and intervention measures [10, 11]. If we extrapolate to all zoonoses, which account for up ~ 75% of all emerging infectious diseases, the lives saved and economic benefits to this trip-wire-like stance in which we monitor-detect-mitigate vs. detect-respond has the potential to ensure a truly pandemic-resilient world.

Embracing the One Health approach as a proactive sentinel system for H5N1 surveillance signifies a transformative shift from reactive to proactive public health. By focusing on early detection of zoonotic threats, we can implement preventive measures that safeguard human and animal health, ultimately reducing the risk of pandemic outbreaks. Investing in One Health strategies is not just a prudent measure but a hopeful step toward a safer, more resilient future against the looming threats of H5N1 and other emerging infectious diseases.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

References
1. Puryear WB, Jonathan A, Runstadler. High-pathogenicity avian influenza in wildlife: a changing disease dynamic that is expanding in wild birds and having an increasing impact on a growing number of mammals. J Am Vet Med Assoc. 2024;262:601–9. https://doi.org/10.2460/javma.24.01.0053. accessed Aug 3, 2024.
2. Campagna C, Uhart M, Falabella V, Campagna J, Zavattieri V, Vanstreels RET, Lewis MN. Catastrophic mortality of southern elephant seals caused by H5N1 avian influenza. Mar Mam Sci. 2024;40:322–5. https://doi.org/10.1111/mms.13101.
3. World Health Organization (WHO). (2023). Influenza (seasonal). Retrieved from [WHO website](https://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal)).
4. Jones BA, Grace D, Kock R, Alonso S, Rushton J, Said MY, McKeever D, Mutua F, Young J, McDermott J, Pfeiffer DU. Zoonosis emergence linked to agricultural intensification and environmental change. Proc Natl Acad Sci. 2013;110:8399–404. https://doi.org/10.1073/pnas.1208059110.
5. Clark D, Antwi-Boasiako G, Brook RK, Epp T, Jenkins E, Lambert S, Soos C. Understanding and strengthening wildlife and zoonotic disease policy processes: a research imperative. Zoonoses Public Health. 2022;69(6):768–76. https://doi.org/10.1111/zph.12981. Epub 2022 Jul 13. PMID: 35822519.
6. One Health High-Level Expert Panel (OHHLEP), Hayman DTS, Adisasmito WB, Almuhairi S, Behravesh CB, Bilivogui P, Bukachi SA, Casas N, Becerra NC, Charron DF, Chaudhary A, Ciacci Zanella JR, Cunningham AA, Dar O, Debnath N, Dungu B, Farag E, Gao GF, Khaitsa M, Machalaba C, Mackenzie JS, Markotter W, Mettenleiter TC, Morand S, Smolenskiy V, Zhou L, Koopmans M. Developing one health surveillance systems. One Health. 2023;17:100617. https://doi.org/10.1016/j.onehlt.2023.100617. PMID: 38024258; PMCID: PMC10665171.
7. Zinsstag J, Utzinger J, Probst-Hensch N, Shan L, Zhou XN. Towards integrated surveillance-response systems for the prevention of future pandemics. Infect Dis Poverty. 2020;9(1):140. https://doi.org/10.1186/s40249-020-00757-5. PMID: 33028426; PMCID: PMC7539270.
8. Morens DM, Fauci AS. Emerging Pandemic Diseases: How We Got to COVID-19. Cell. 2020;182(5):1077–1092. https://doi.org/10.1016/j.cell.2020.08.021. Epub 2020 Aug 15. Erratum in: Cell. 2020;183(3):837. https://doi.org/10.1016/j.cell.2020.10.022. PMID: 32846157; PMCID: PMC7428724.
9. Zhang XX, Jin YZ, Lu YH, Huang LL, Wu CX, Lv S, Chen Z, Xiang H, Zhou XN. Infectious disease control: from health security strengthening to health systems improvement at global level. Glob Health Res Policy. 2023;8(1):38. https://doi.org/10.1186/s41256-023-00319-w. PMID: 37670331; PMCID: PMC10478312.
10. Kramer LD, Li J, Shi PY. West Nile virus. Lancet Neurol. 2007;6(2):171–81. https://doi.org/10.1016/S1474-4422(07)70030-3.
11. Nelson MI, Vincent AL. Reverse zoonosis of influenza to swine: new perspectives on the human-animal interface. Trends Microbiol. 2015;23(3):142–53. https://doi.org/10.1016/j.tim.2014.12.008.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.